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Title:	What can we learn from previous tracer tests to optimize a colloid-facilitated transport test?
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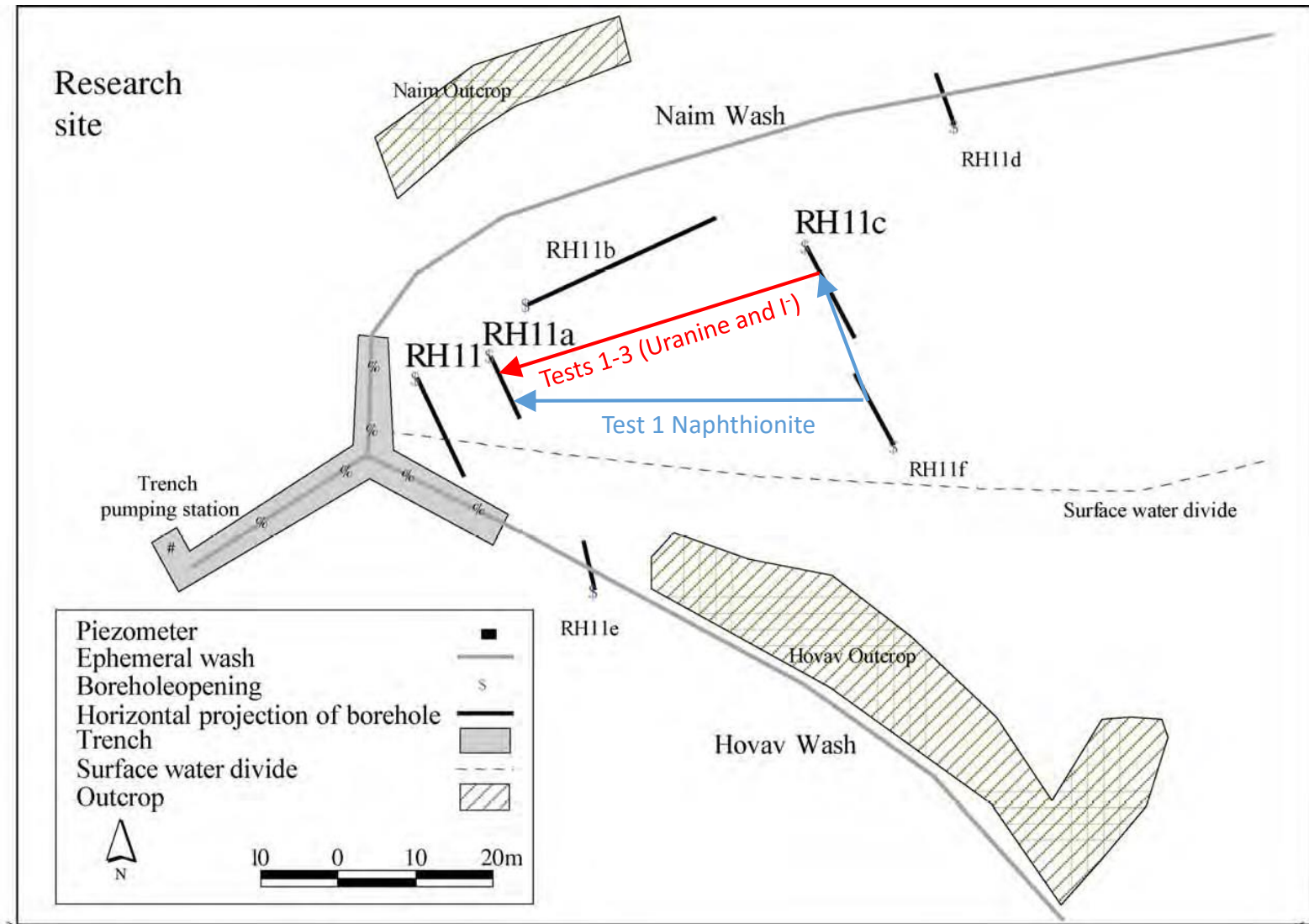
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What can we learn from previous tracer tests to optimize a colloid-facilitated transport test?

Paul Reimus
Los Alamos National Laboratory

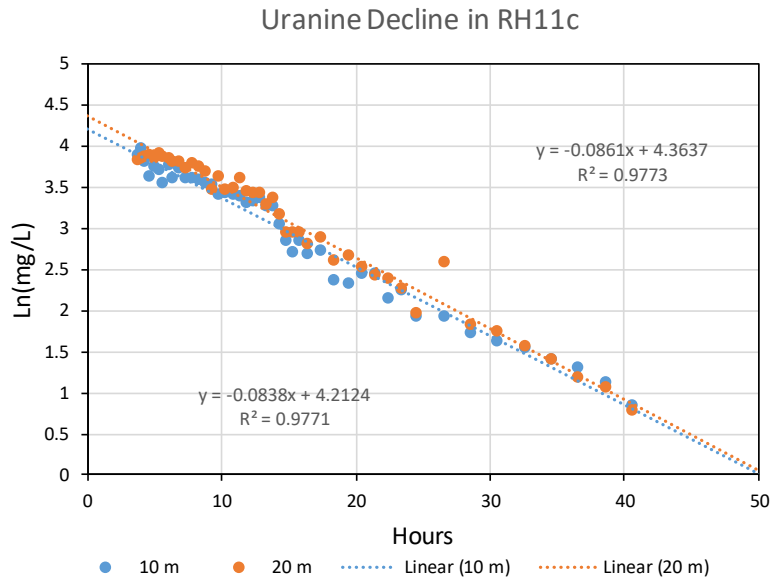
Previous Tests



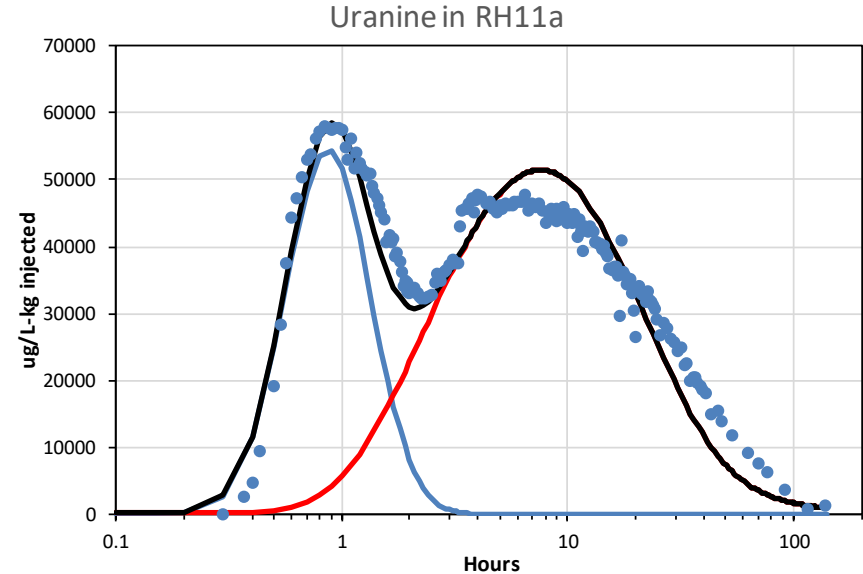
Map from Kurtzman et al., 2005

Test 1 (Uranine)

Approximately 89% Recovery



Volumetric Flow Estimate through RH11c: ~32 L/hr
RH11a Production Flow was 480 L/hr

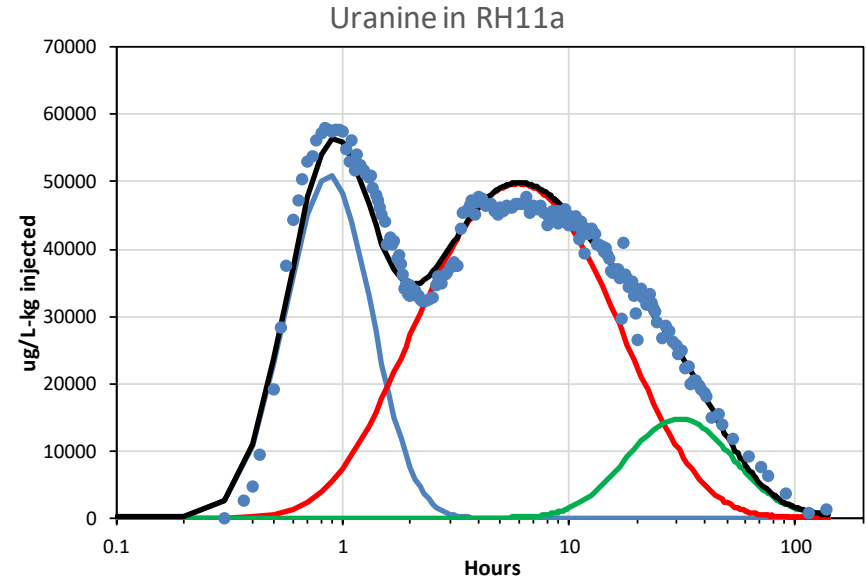
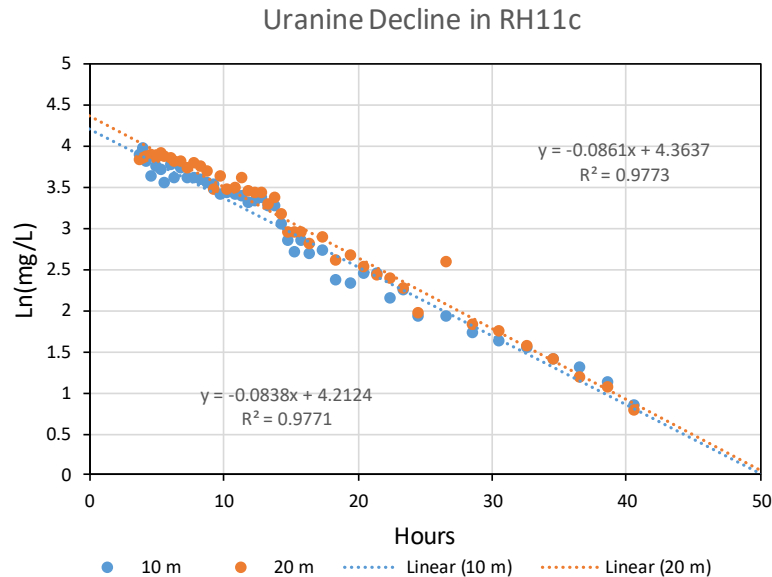


Two-Pathway Fit:

	Path 1	Path 2
Mass Fraction	0.027	0.87
Mean Time, hr	0.78	136
Peclet No.	7	0.05

Test 1 (Uranine)

Approximately 89% Recovery



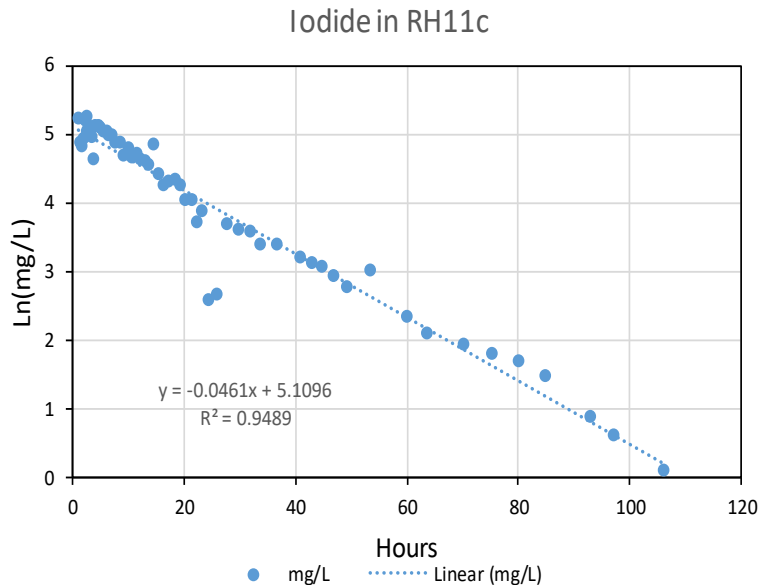
Volumetric Flow Estimate through RH11c: ~32 L/hr
RH11a Production Flow was 480 L/hr

Three-Pathway Fit:

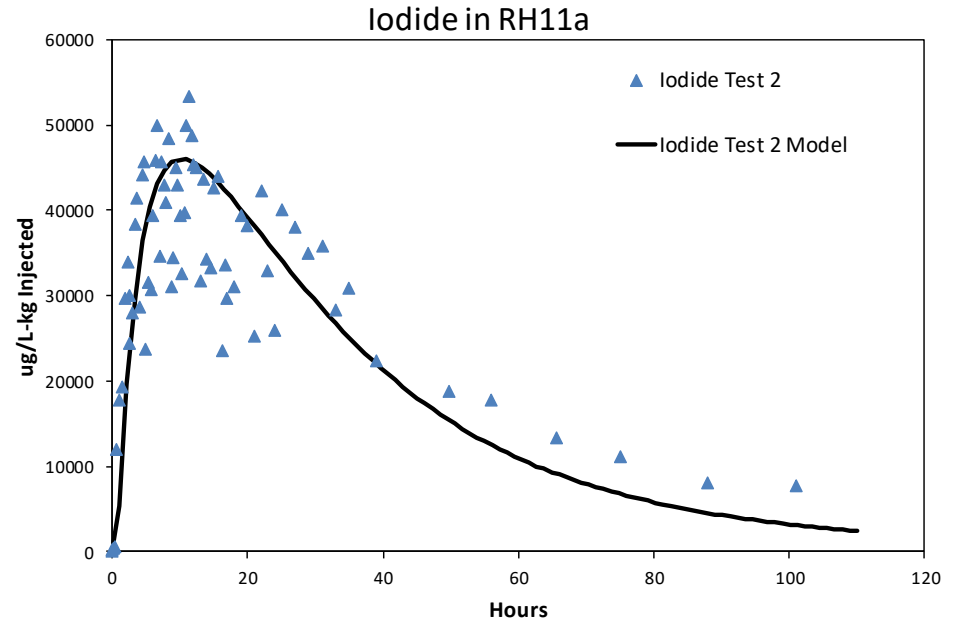
	Path 1	Path 2	Path 3
Mass Fraction	0.025	0.492	0.376
Mean Time, hr	0.78	4	30
Peclet No.	7	1.6	6

Test 2 (Iodide)

Approximately 100% Recovery



Volumetric Flow Estimate through RH11c: ~17.5 L/hr
RH11a Production Flow was 480 L/hr

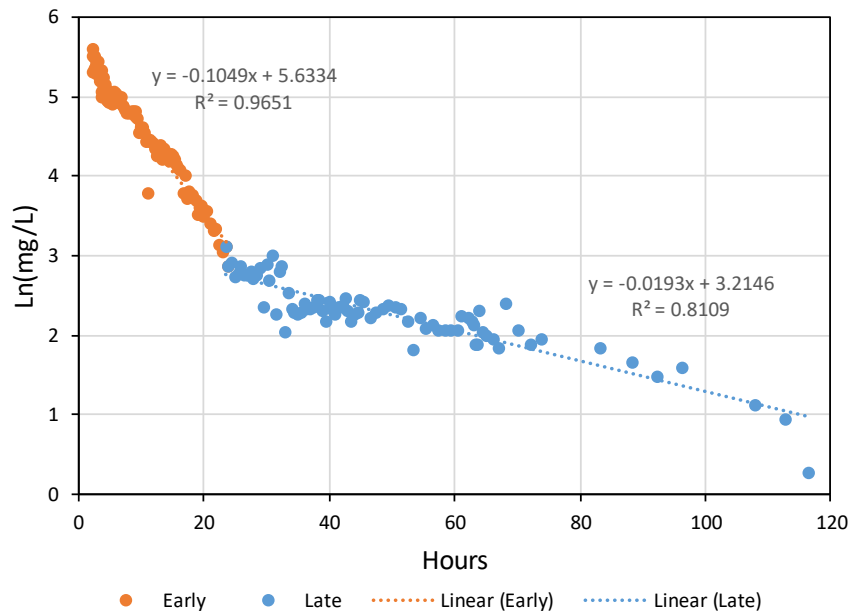


Mean Residence Time = 23 hr
Peclet Number = 0.3

Test 3 (Iodide)

~25% Recovery to 61 hr
~37% Total

Iodide in RH11c



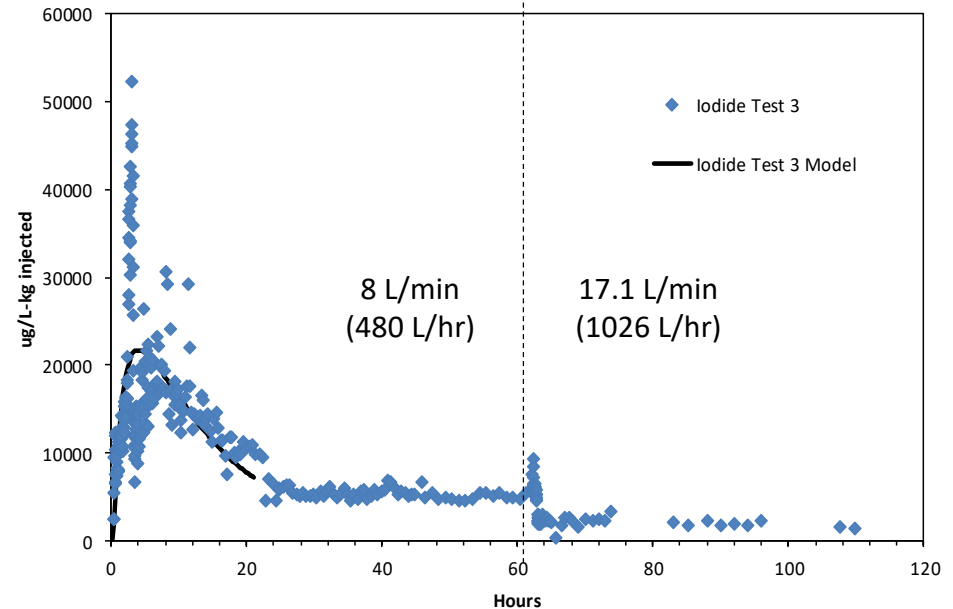
Volumetric Flow Estimate through RH11c:

~40 L/hr in 1st 24 hr
~7.3 L/hr after 1st 24 hr

RH11a Production Flow was:

480 L/hr until ~61 hr
1026 L/hr after 61 hr

Iodide in RH11a

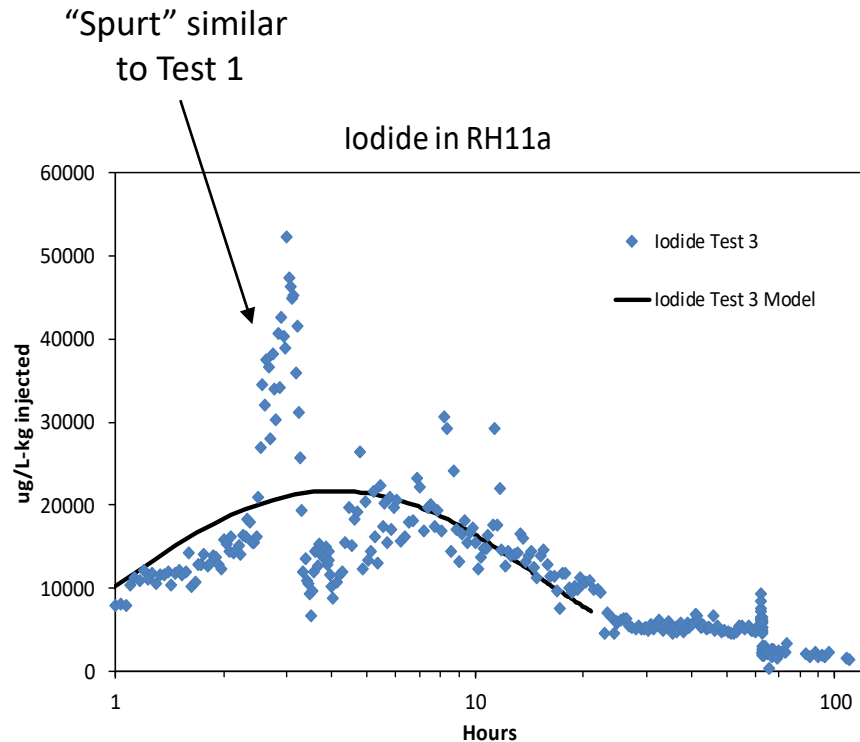


Modeled only until apparent change in RH11c

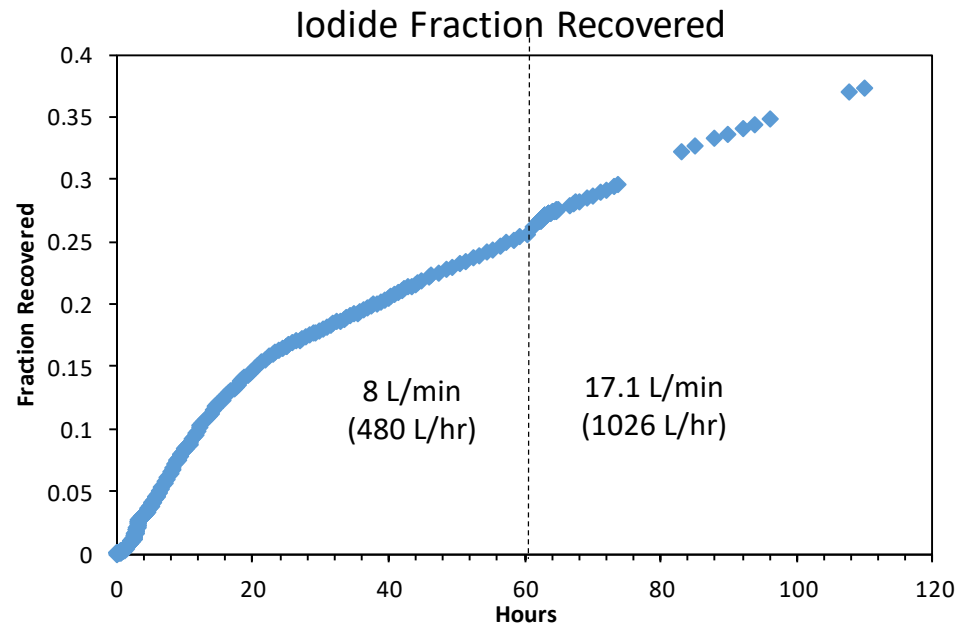
After ~24 hr: $\frac{\text{Late Flow}}{\text{Early Flow}} = \frac{\text{Early Concentration}}{\text{Late Concentration}}$

Consistent with diffusion-controlled tailing,
but cannot definitively conclude this

Test 3 (Iodide)



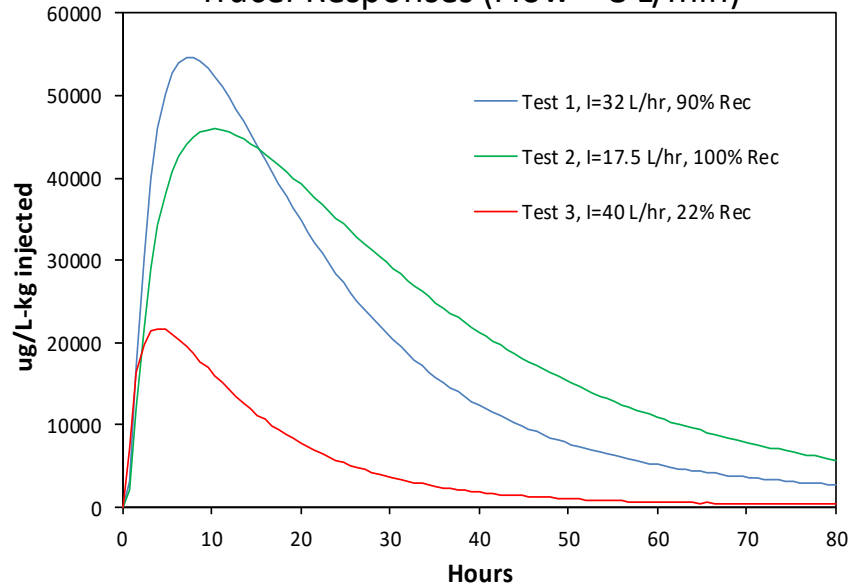
Mean Residence Time = 31 hr
Peclet Number = 0.07



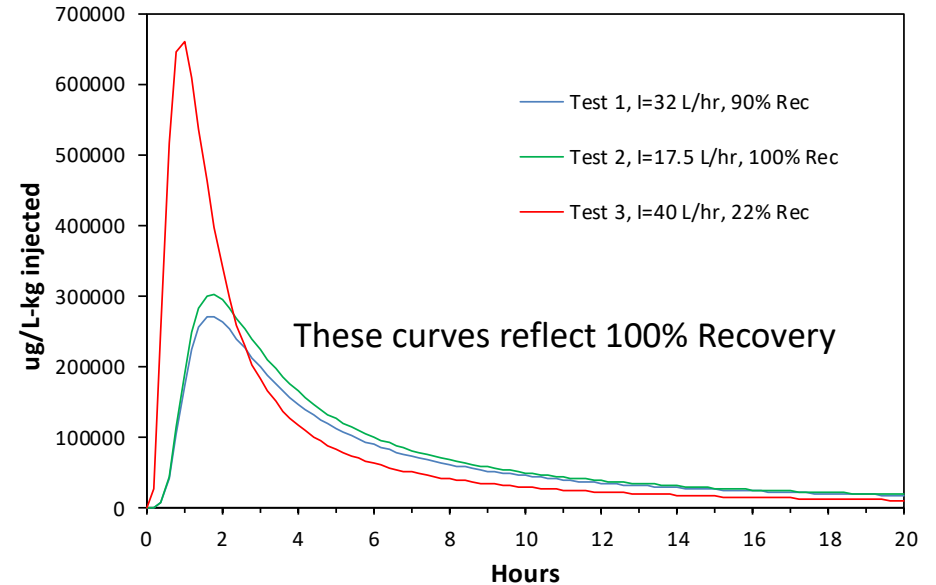
No significant change in recovery rate before
and after flow rate change
(consistent with diffusion control)

All Tests (Non-Rapid Flow Pathways)

Tracer Responses (Flow = 8 L/min)



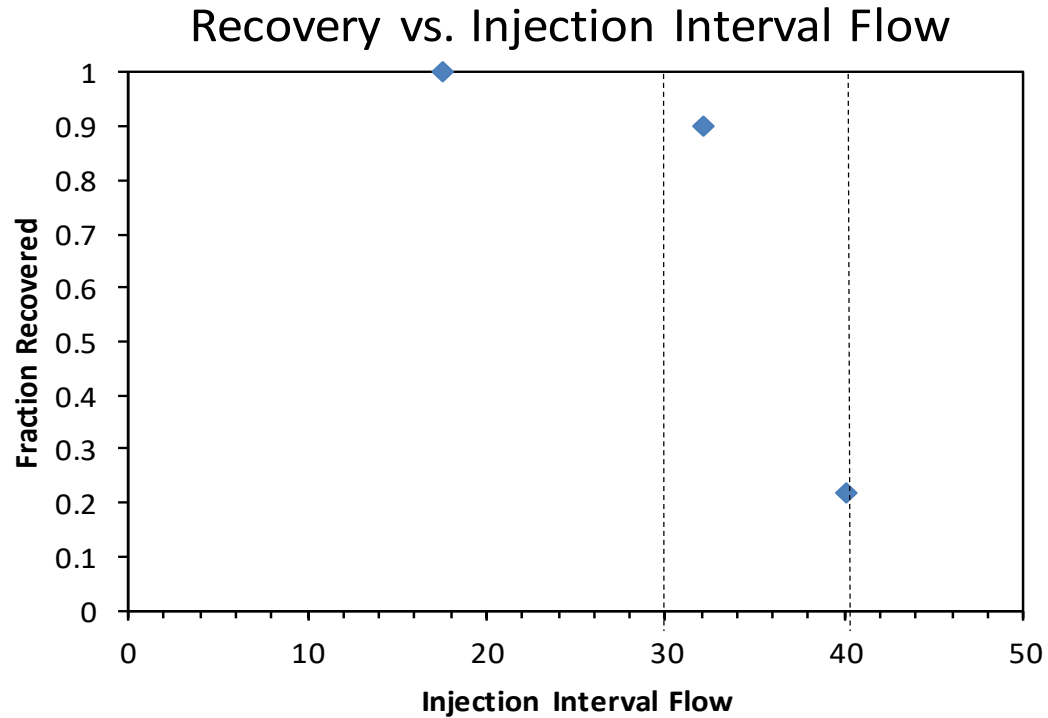
Residence Time Distributions in the Formation



These curves assume injection interval turns over every 12 minutes (instead of 10 hrs or more)

These responses are starting to look like the “spurts”

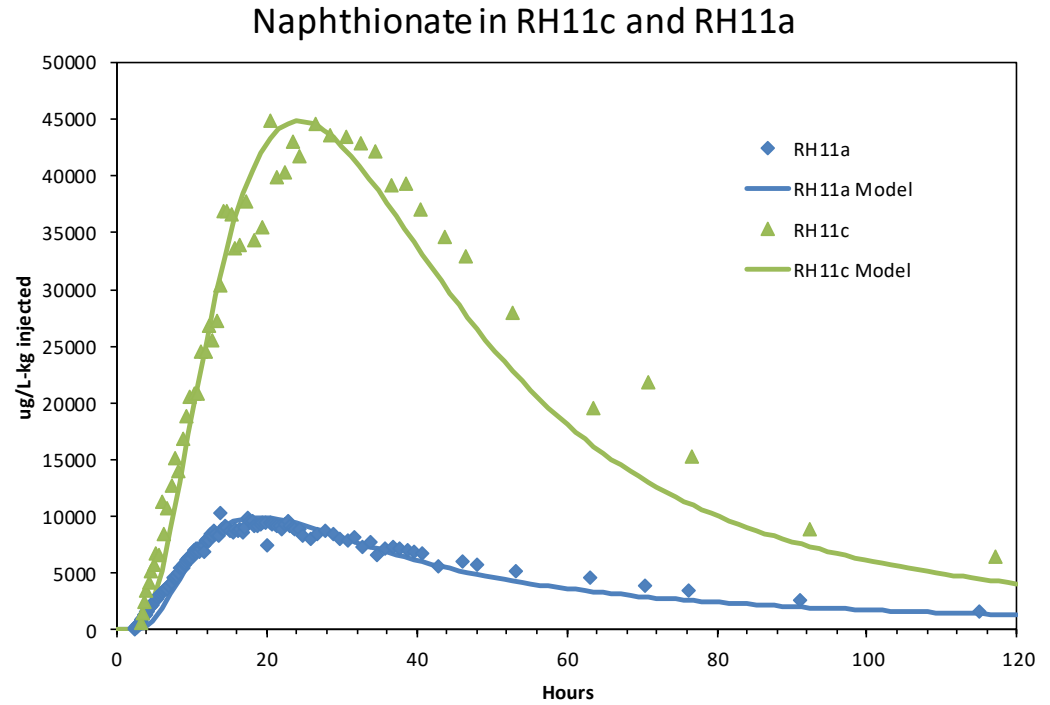
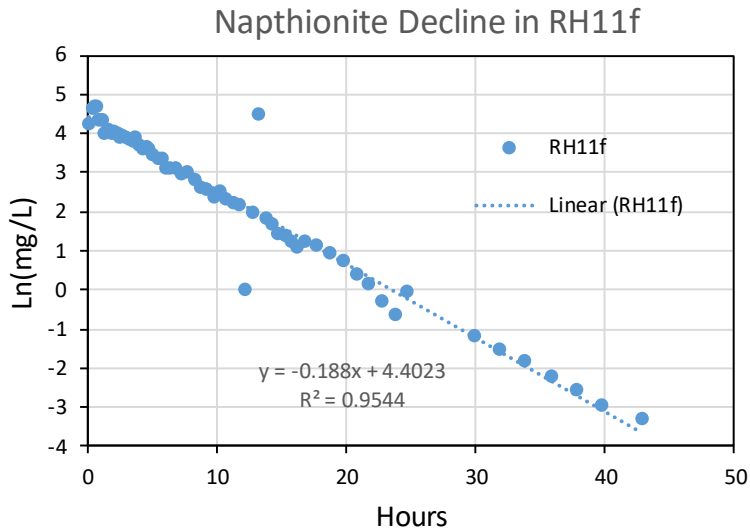
Recovery vs. Injection Interval Flow



Somewhere between an injection flow of 30-40 L/hr,
recovery drops off significantly

Also, tendency to see “spurts” at higher flows

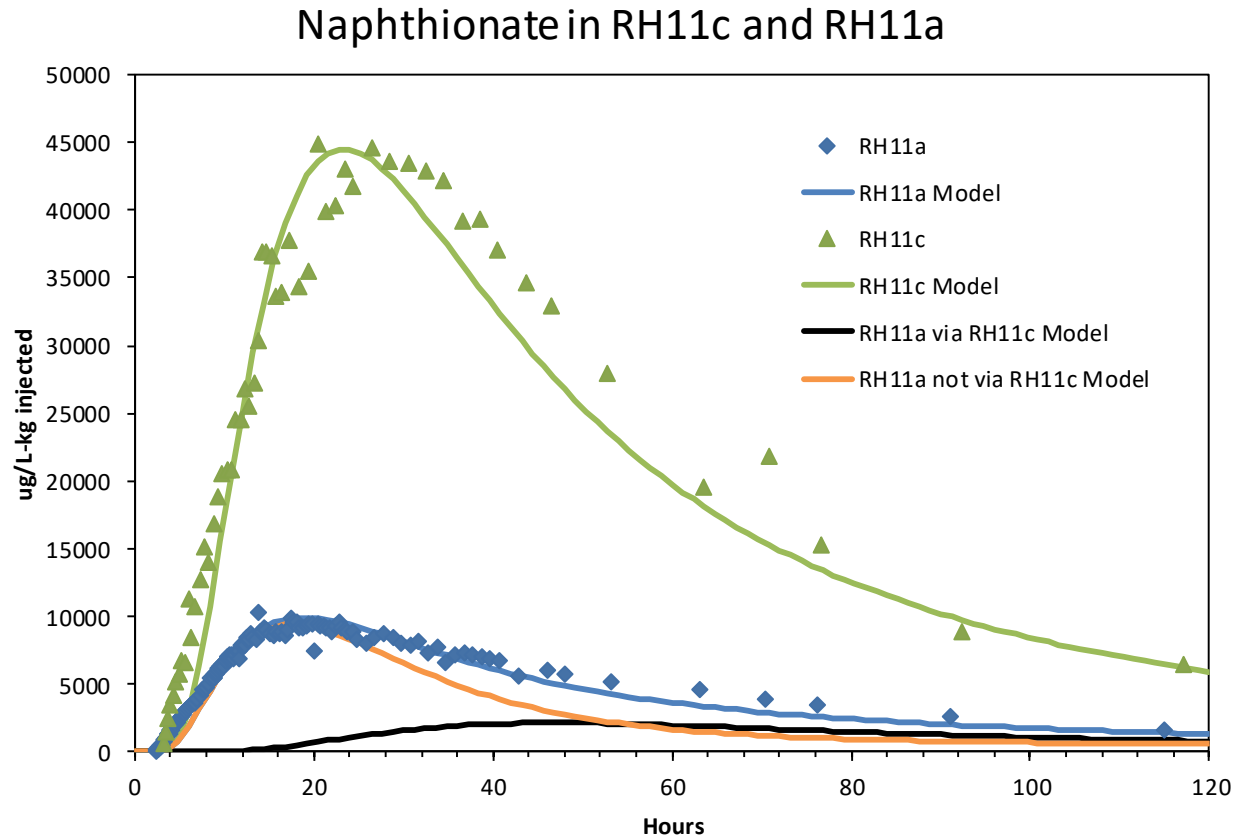
RH11f to RH11c and RH11a



	RH11c	RH11a
Mass Fraction	0.09	0.33
Mean Time, hr	68	140
Peclet No.	1.5	0.5

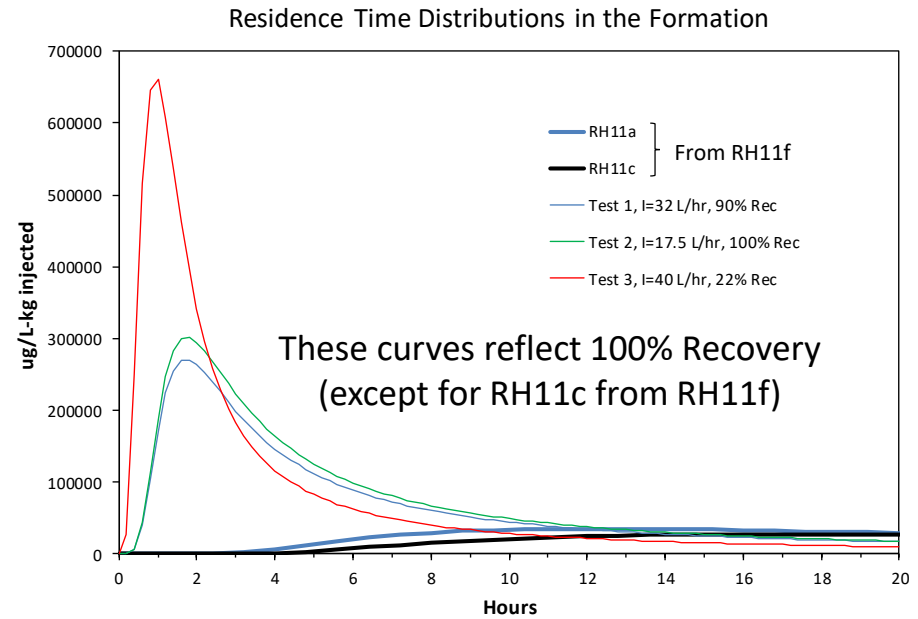
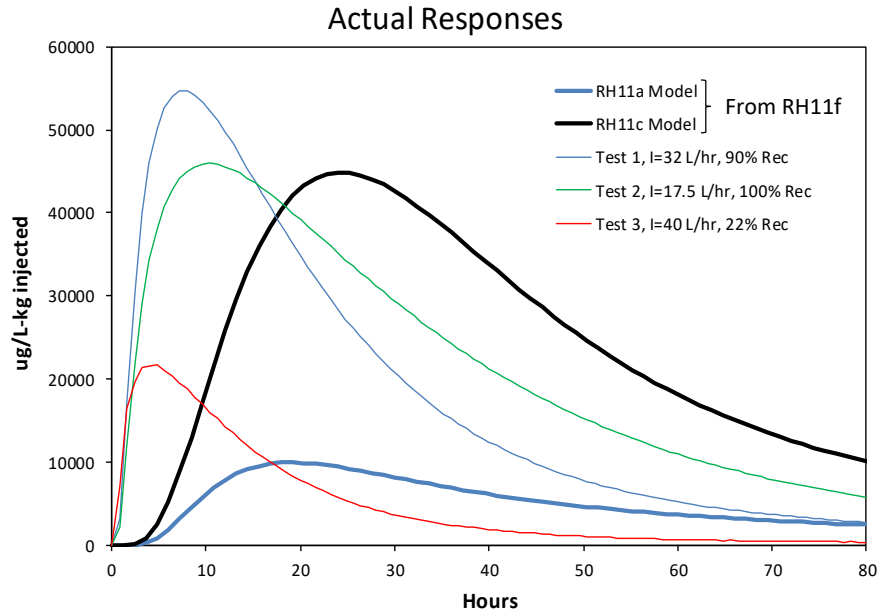
About 25% of what shows up at RH11a goes through RH11c!

Deconvolution of RH11f-to-RH11a via RH11c



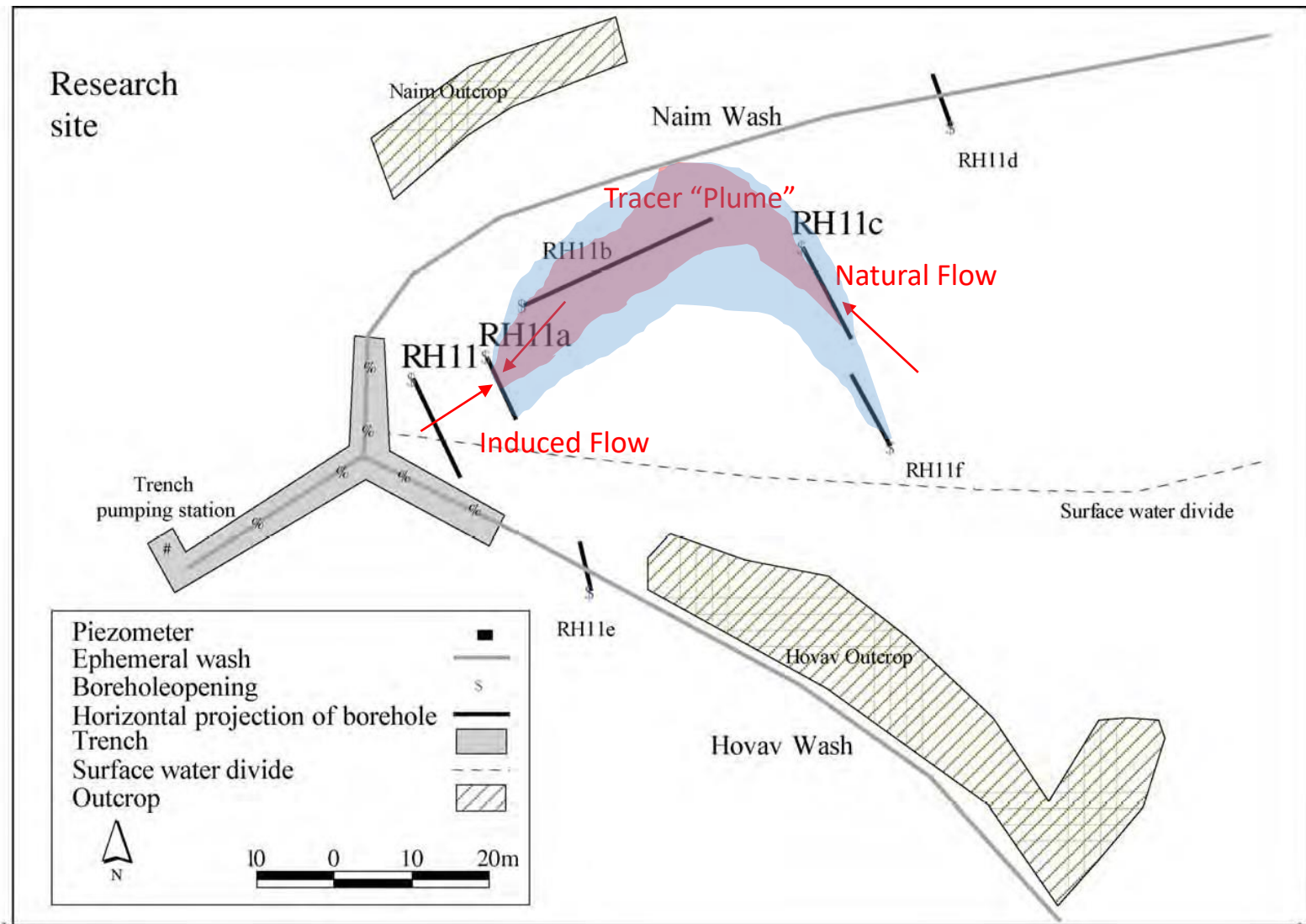
Assumes that everything showing up at RH11a follows Pathway 2 from RH11c to RH11a in the model with only 2 Pathways

Comparison of Responses from RH11c and RH11f



Injection into RH11f increases residence time in formation by a factor of at least 4, but with decreases in observed concentrations and recoveries

Conceptual Model



Map from Kurtzman et al., 2005

Takeaway Points

- Very rapid travel times, and extreme dispersion (some of this is probably diffusion, but still a lot of dispersion)
 - From RH11c: Tracer peaks occur in less than 2 hrs in formation
 - From RH11f: Tracer peaks occur in 8-10 hrs in formation
- Very small Peclet numbers (extreme dispersion) reflects multiple fracture flow pathways
- Recovery from RH11c decreases as natural flow velocity increases (tracer swept out of pumping capture zone)
- “Spurts” of small mass fractions may occur from RH11c to RH11a
- Injection into RH11f offers longer residence times in formation and two breakthrough curves, but concentrations and recoveries at RH11a are lower
- Recommendation?:
 - Do a conservative tracer injection in RH11c and if deduced flow in RH11c is less than 32 L/hr, then inject cocktail in RH11f
 - If deduced flow >32 L/hr in RH11c, then inject cocktail in RH11c